37. STAR CLUSTERS and ASSOCIATIONS (AMAS STELLAIRES et ASSOCIATIONS)

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1 Introduction

The last three years have been very productive for cluster research. More than 450 references for open clusters and more than 800 for globular clusters have been collected from the literature and Astronomy and Astrophysics Abstracts (Vol. 52 to 56). The observations present very broad scope thanks to the new instrumental facilities like infrared arrays and the X-ray and IR satellites. Our knowledge of how and where open clusters form has been considerably advanced with the advent of infrared arrays images which has revealed the presence of compact, centrally condensed clusters of newly formed stars embedded in, or closely associated with dense cores of giant molecular clouds. The present report tries to survey the activity in these domains, summarize the results and trends, and collect the information on the observed clusters and associations. But, owing to the large number of references, it is not possible to quote every paper. A higher priority has been given to the new data obtained for star clusters, which should help everybody to be easily informed of the observations made during the past three years. Therefore the traditional form of the report has been largely maintained. Abstracts and papers in conference proceedings have usually not been quoted here to save place and no attempt has been made to include unpublished material. For complete bibliographic information, the Astronomy and Astrophysics Abstracts, chapters 121 (young stellar objects), 131 (star formation), 152 (stellar associations), 153 (open clusters), 154 (globular clusters), and 156 (Magellanic Clouds) remain the best source. To improve the efficiency of literature retrieval, it would be important that the first keyword refers to open, respectively globular clusters, whatever the observational data may be (proper motions, radial velocity, photometry and so on). The database for stars in open clusters (Mermilliod 1992) offers an up-to-date bibliographic search facility based on keywords. Murtagh and Adorf (1993) have given a short report of the astronomical literature publicly accessible on-line. The subject of low-mass star formation in southern molecular clouds has been reviewed in a comprehensive ESO report edited by Reipurth (1991), which provides extensive references to the literature.

Mermilliod J.-C. 1992, Bull Inform. CDS 40, 115
Murtagh F., Adorf H.-M. 1993, The Messenger, no 72, 45
Reipurth B. 1991, ESO Scientific Report no 11

2 Symposia, Colloquia and Workshops

No IAU symposia or colloquia directly related to star clusters have been held during this period, but several meetings have taken place.
- "Formation and evolution of star clusters", 102nd ASP Meeting, (Boston, July 14-15, 1990) edited by K. Janes (ASP Conf. Ser. vol 13, 1991);
- "Young star clusters and early stellar evolution" held in Vulcano (Sept. 16-20, 1991) edited by F. Palla, P. Persi and H. Zinnecker (Mem. Soc. Astr. It. 62 no 4, 1991);
- "Star clusters and stellar evolution", held in Teramo (Sept. 18-20, 1991), edited by E. Brocato, F.R. Ferraro and G. Piotto (Mem. Soc. Astr. It. 63 no 1, 1992);
- "The globular cluster-Galaxy connection" (1992 Santa Cruz summer Workshop) edited by J. Brodie and G. Smith, ASP Conf. Ser. vol. 48 (1993);
- "Dynamics of globular clusters" (held in July 1992), edited by S. Djorgovski and G. Meylan, ASP Conf. Ser. vol. 50 (1993).

Other meetings, at which the subject of star clusters figured more or less prominently, include:
- "The Magellanic Clouds", IAU Symp. no 148, (Sydney, July 9-13, 1990), edited by R. Haynes and D. Milne (Kluwer Academic Publishers);
- "Astrophysical ages and dating methods" (Paris, June 26-30, 1989), edited by E. Vangioni-Flam, M.

J. Bergeron (ed.), Reports on Astronomy, Vol. XXIIA, 425–444.

Cassé, J. Audouze and J. Tran Thanh Van (Editions Frontières, 1990);
- "Angular momentum evolution of young stars", Nato Advanced Research Workshop held in Noto (Sept. 17-21, 1990), edited by S. Catalano and J.R. Stauffer (Kluwer Academic Press).

3 Catalogues of cluster data

The database for stars in open clusters (Mermilliod 1992) has been developed continuously and a dozen copies have been distributed. Collaboration on this project is welcome. A solution is searched for to make it available more easily to the astronomical community. The 5th edition of Lynga's catalogue has not been updated, and it would be useful to elaborate a new version because better or new parameters for many clusters have been obtained since 1987. Garmany and Stencel (1992) have critically evaluated the reality of 25 OB associations ($55^o < l < 150^o$). They give lists of the member stars and their parameters, and of red supergiant candidates for association membership. Carpenter et al (1993) have produced a list of embedded clusters based on luminous IRAS point sources. Pasztor et al (1993) have searched for embedded clusters in the Cepheus-Cassiopeia region also from the IRAS point source catalogue. Fusi Pecci et al (1992) have produced a catalogue of 425 candidate blue stragglers in 21 globular clusters.
Due to the large amount of observational data available for galactic globular clusters and Magellanic Cloud clusters resulting, for a large part, from the extensive application of CCD photometry to the study of these objects, it would be important to develop specialized databases to keep this information publicly accessible in machine-readable form, through the now extended network facilities.

Carpenter J.M., Snell R.L., Schloerb F.P., Skrutskie M.F. 1993, ApJ 407, 657
Fusi Pecci F., Ferraro F.R., Corsi C., Buonanno R. 1992, AJ 104, 1831
Garmany C.D., Stencel R.E. 1992, A&AS 94, 211
Mermilliod J.-C. 1992, Bull Inform. CDS 40, 115
Pasztor L., Toth L.V., Balasz L.G. 1993, A&A 268, 108

4 Stellar associations and star-forming regions.

4.1 Observational trends

The list of observations in the various types of stellar associations and embedded clusters may seem small, although this field of astronomy has been subject to the most impressive development during the past years. It represents one of the most exciting research domains in the near future. This is partly due to the selection of thoses references dealing with the stellar component of associations and star-forming regions. Indeed a large part of the observation work is devoted to the mapping and investigation of the parent giant molecular clouds. While photometric (UBV, uvby, Walraven) or spectroscopic observations are still done to improve the member selection, find new and fainter members, and better define their properties (binarity, peculiarity, activity), the research tends to multi-disciplinarity. More attention is given to the galactic environement and the relation between the formed stars and the parent molecular clouds. Space observations comprising the X-ray, UV and IR wavelength domains have been obtained and will be published in the near future.
Interesting review papers have been written by Larson (52.131.277), Lada & Lada (54.131.223). Important contributions are presented in the NATO ASI series volume devoted to "The physics of star formation and early stellar evolution" edited by C.J. Lada and N.D. Kylfis (1991, Kluwer Academic Press) and in the III Canary Islands winter school of astrophysics "Star formation in stellar systems" edited by G. Tenorio-Tagle, M. Prieto and F. Sánchez (1992, Cambridge Univ. Press). The subject of star formation is reviewed by Shu (54.131.340) from a theoretician's point of view, and the observations are presented by Evans (54.131.341).
Cloud mapping with infrared arrays leaded to the discovery of several embedded clusters (53.131.063, 53.153.027, 54.153.065, 56.153.004) containing tens or even hundreds of young stellar objects. The four embedded clusters found in the giant molecular cloud Lynds 1630 and associated with the star-forming regions NGC 2023, 2024, 2068 and 2071 are centrally condensed. The stellar densities are high. Two clusters, NGC 2024 and 2071, show evidence for spatial magnitude segregation, with the brighter stars displaying a tendency to be more centrally condensed than the fainter sources. Verschueren (52.153.001) has investigated the cluster collapse that may happen before the gaz removal sets in.

These efforts result in a variety of designations both for the fields and the stars. It would be important to develop a coherent system of designation for each new cluster or star-forming region and maintain a catalogue of the stellar components with positions and cross-references for young stellar objects seen in visible light or discovered through their X-ray and/or infrared emissions. Although these new subjects give rise to much competition, systematic observations and exchange of information would be extremely profitable to the development of our knowledge to avoid repeating the errors made in the past study of open or globular clusters, which results now in a vast amount of data, but large gaps and disastrous incompleteness.
Observations of O and T associations are very close to the subject of star-forming regions and embedded clusters, so that the distinction between these domains may be revised.

4.2 Table 1. OB Associations

Ara OB1
56.152.009 uvbyβ phot.
CMa OB1
52.152.001 Walraven phot.
54.131.094 IRAS, IR em, O st.
Car OB2
Kaltcheva & Georgiev (1993) uvbyβ phot.
Cas OB9
53.152.004 Ap, Am st.
Cas OB14
53.152.004 Ap, Am st.
Cep OB2
52.113.041 UBVRI pg phot, Hα st.
53.131.136 IRAS, CO survey, IR src.
Cep OB3
53.113.032 uvby phot.
53.119.009 uvby light curve, eb.
56.113.003 uvbyβ phot.
Cep OB4
52.131.128 CO survey.
Cyg OB1
52.152.006 Glazar UV obs.
54.121.084 UV obs, spatial distr st.
54.131.245 IUE obs, sp, OB st, int/st gas.
56.152.008 IRAS, IR shell.
Cyg OB2 (VI Cygni)
52.152.008 uvby, IR phot.
52.117.057 radio, IR monit contact bin.
53.152.001 UBV CCD phot, sp cl, HRD, imf.
53.152.005 uvby, JHK phot, ext law.
56.121.035 IRAS, IR src.
Cyg OB3
54.131.245 IUE obs, sp, OB st, int/st gas.
Cyg OB4
53.152.004 Ap, Am st.
Lac OB1
52.115.010 sp, Hγ meas. temp, log g.
53.152.004 Ap, Am st.
52.153.011 HI distr.
Mon OB1
52.152.001 Walraven phot.
Per OB1
52.152.006 Glazar UV obs.
54.121.084 UV obs, spatial distr st.
Ori OB1
52.152.001 Walraven phot.
52.115.010 sp, Hγ meas. temp, log g.
53.152.007 rv, sb.
53.114.090 survey, Hα em st.
53.122.231 flare st.
55.121.056 Hα em st.
56.152.012 O abund.
Sco OB1
52.152.004 UBV, uvby phot, rv, sp cl.
52.152.006 Glazar UV obs.
54.121.084 UV obs, spatial distr st.
54.153.005 d, red, age, memb.
55.152.007 lf.
Sco OB2
52.152.001 Walraven phot.
Sco-Cen
56.002.102 UBVβ phot.
56.131.023 st, shell i/s mat.
56.133.001 IRAS src, ident.
Sct OB2
52.152.001 Walraven phot.
Vul OB4
53.152.004 Ap, Am st.

4.3 Table 2. R and T Associations

Cha I
52.131.171 IRAS map, IR phot.
53.121.016 IR phot.
55.121.019 lf.
55.131.116 review.
56.121.017 sp, X-ray src.
Hartigan (1993) new T Tauri st.
Cha II
55.131.116 review.
56.121.001 IRAS search, pms st.
56.131.036 d, HRD.
Hartigan (1993) new T Tauri st.
CMa R1
55.131.268 IRAS, IR em, st src.
Mon R2
52.131.065 mol outflow.
53.131.092 mol outflow.
56.131.040 sub mm/mm obs.

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4.4 Table 3. Star forming regions / embedded clusters

NGC 712
52.131.165 CCD image.
55.131.079 HH obj.
IC 1396
53.131.136 IRAS search, yso.
Rho Oph
52.121.031 mm survey, yso.
52.131.201 DCO+ em, protostar.
53.121.020 rot mod, T Tauri st.
56.121.042 JHK survey, yso.
56.121.108 VLBI survey, yso.
56.131.088 UV i/s ext.
Vrba et al (1993) phot, sp cl, pol.
GM 24
53.153.027 opt, IR CCD images, IR ex.
55.153.029 radio, IR, opt obs, rev.
L1228
52.131.207 Hα em st.
L1251
Kun & Prusti (1993) d, memb.
L1551
54.131.369 mol outflow
55.131.258 Hα image, HH obj.
56.121.016 HH obj.
L1630
53.131.163 2.2μm survey, yso.
L1641
52.131.119 X-ray src.
53.121.009 HH obj.
54.131.073 mol outflow, yso.
L1642
56.153.066 UBVRI phot.
LkHα 101
55.153.028 IR survey, CMD, age.
Lupus
Hughes et al (1993) phot, sp, d.
Serpens
56.153.004 JHKnbL, "ice" image, 163 st obj.
R CrA
56.121.002 IRAS, en dist, pms st.
Rosetta
Block et al (1993) emb cl.
RSF 2 Cyg
53.131.319 UBVR phot, Hα em.
Taurus-Auriga
53.121.005 pm, sp.
55.121.012 IRAS IR survey.
55.121.041 IRAS, pms st.
56.121.018 PMS, age.
56.131.098 dyn, review.

4.5 References to 1993 papers on associations and star-forming regions

Block D.L., Geballe T.R., Dyson J.E. 1993, A&A 273, L41
Hartigan P. 1993, AJ 105, 1511
Hughes J., Hartigan P., Clampitt L. 1993, AJ 105, 571
Kaltcheva N.T., Georgiev L.N. 1993, MNRAS 261, 847
Kun M., Prusti T. 1993, A&A 272, 235
Vrba F.J., Coyne G.V., Tapia S. 1993, AJ 105, 1010

5 Open clusters

To make the text a little easier to read, I have dropped many references to the observations cited. It is however simple to find them below in section 5.10 presenting the cluster-by-cluster literature citations.

5.1 Photometry

CCD photometry of open clusters has been done for many objects. Many targets were known old open clusters (NGC 188, 2243, 2420, 2682, 6791, 7142) and the observations of these objects has produced improved colour magnitude diagrams that give more constraining tests of stellar evolutionary models. Colour magnitude diagrams for remote or faint, young (NGC 433, Tr 14, 16, Sher 1, Wes 2), intermediate-age (2266, 2355, 2627, 2658, 6603), old (IC 1311, Be 32, King 2, King 11), clusters not previously observed were obtained with CCD cameras. BVI CCD photometry has been used to identify very low-mass stars in the Pleiades and α Persei clusters. BV and RI filters are mainly used, while U is also sometimes observed. The main goal of these studies is to obtain colour-magnitude diagrams to estimate the distance and age of the clusters. However the lack of U-B colours limits the possibilities of reddening and membership determination. Both the discrimination of field stars and the determination of cluster parameters is more difficult and this makes the fitting of theoretical isochrones confusing, when the colour-magnitude diagrams have not been cleared of non-member stars. Comparison fields should be obtained more often to estimate the degree of contamination by field stars. The addition of red and near infrared filters produces better diagrams for red stars. CCD cameras have also been developed for the uvby (NGC 457, 1893, Be 94, Bo 1) and Washington (NGC 2266, 3680, Be 32) systems.
The photoelectric photometry in the UBV system is still active for clusters with large diameters. The tendency is now to measure a larger number of stars to make more complete studies than was the case in

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the previous years (NGC 129, 436, 637, 1647, 2353, 5460, 5606, 5749, 5822, 6134, 6193, 6494, 6823, Ros 3, Tr 37, vdBH 99). Observations have also been published in the uvbyβ system for several clusters (Hyades, Coma Ber, NGC 1502, 2169, Tr 16, vdBH 99). Photographic photometry has often been combined with photoelectric measurements or with CCD observations (NGC 188, 225, 957, 1039, 5822, 6716). Infrared (JHK) observations of stars in very young open clusters have been carried out to study the variable extinction (1893, 2264, 6611).
Several photometric programmes aimed at studying the variablity of cluster stars have produced remarkable results. They are discussed below.

5.2 Spectroscopy

New estimates of the chemical composition and [Fe/H] of open clusters were obtained for dwarfs in nearby clusters, for turn-off stars in NGC 188, 752 and 2682, and for red giants in several old clusters (Friel & Janes 1993). The carbon isotope ratio in giant branch and clump stars of NGC 2682 (M67). Excess mixing is probably required to explain the anomalously low ratios observed in stars at the tip of the red giant branch and in the clump. Lithium abundances in the Hyades, Coma Ber, Orion, NGC 188, 2682, IC 4651 were determined. Much spectroscopic effort has been devoted to observe the CaII H-K and Hα strength to study the chromospheric activity of late-type dwarfs in nearby clusters (53.153.011, 53.153.050).

5.3 Proper motions

The determination of proper motions has been done for several clusters, although many studies were done for old favourite clusters (Hyades, Pleiades, Praesepe, α Persei, NGC 752, 2682, 7092). Very large numbers of stars were measured in the nearby open clusters (Pleiades, α Persei) to search for low-mass or very low-mass members and brown dwarfs. New clusters have also been studied (NGC 225, 1039, 2286, 6939, Tr 37). New or improved methods to compute membership probabilities have been proposed (52.153.002, 52.153.005, 52.153.008, 52.153.019, 54.153.013).

5.4 Radial velocity

This period was quite prolific in radial velocity determinations. Classical or CCD spectra were obtained for upper main sequence stars in several clusters (NGC 6231, Orion, Pleiades, IC 4665, Cr 228, Tr 14, Tr 16). Two groups showed that precision radial velocities for early type stars were now feasable by observing the B-type stars in the Pleiades (53.036.025, 54.111.004) and several northern young open clusters (54.153.056). Photoelectric radial velocities were published for red giants in open clusters by several groups (NGC 2360, 2423, 2682, 5822, 6134, 6811, 6939, IC 4756), and for 118 red giants in 18 open clusters were published (53.153.035). The large observational efforts devoted to M67 (52.153.020) produced orbits for 22 upper main sequence stars and red giants and resulted in the discovery of several additional spectroscopic binaries.

5.5 Variable stars

Several studies were devoted to the observations of light modulation to determine the period of rotation. Most targets were chosen in the nearby clusters (Pleiades, α Persei, Orion). Such studies are connected with chromospheric activity determination. The Be stars in NGC 869(h Per), 884 (chi Per) and 3766 were extensively observed and long-term variation patterns were brought to light. The programmes undertaken to search for short-period, contact binaries in old open clusters produced very promising results. Four contact binaries were discovered in To 2 (56.153.049) and eleven in Be 39, over a sample of 2000 stars (Kaluzny et al 1993).
Eclipsing and contact binaries in NGC 188, 752, 2682, 3293, 6871, 7209, IC 4665, and 4996 received also some attention. The major survey results published during these three years is the extensive coverage with 5200 CCD frames of NGC 2682 (M67) by Gilliland and collaborators (53.153.002). They reached an unprecedented precision and reported evidence suggestive of p-mode oscillations in a few stars. Serendipitous discovery of other kinds of variable stars was also made.

5.6 Blue stragglers

Most work on blue stragglers has been done in the old cluster M67. Spectroscopic analysis was conducted to determine the lithium abundance (53.153.045) and the abundance pattern (53.153.037) which is found to be similar to that of other stars in the cluster. A preliminary report of a long-term radial velocity monitoring of 9 blue stragglers (with Vsini < 100 km/s) shows that 5, and possibly 7, are binaries. An orbit has been obtained for F190 (55.153.021). Photometric monitoring of blue stragglers located within the instability region showed that two of them (F131 and F190) are variable (54.153.026), while F185 is not. The variability of F190 and the stability of F185 have been confirmed on the basis of a much more extensive CCD survey (55.153.017). Another variable blue straggler, F184, has been analysed in the latter reference. Five contact binaries among blue stragglers have been discovered by Kaluzny et al (1993) in Be 39.

5.7 Brown dwarfs

Infrared search for brown dwarfs in nearby open clusters has continued, from I POSS plates (55.115.007), R&I UK Schmidt plates (53.153.033) or IR array surveys (55.115.014). Selection based on a deep proper motion survey and photometric follow-up in RIJHK for a sub-sample of the stars identified has been done in the Pleiades (54.153.075). It resulted in the identification of a large list of low-mass stars with probable membership of the Pleiades. Spectroscopy has been obtained for one candidate in the α Persei cluster (55.115.012) to define the spectroscopic signature of brown dwarfs, as well as for one candidate in the Hyades moving group (55.115.011). Hamilton & Stauffer (1993) have obtained optical spectrophotometry for several very low-mass stars in the Pleiades. Most good candidates have masses close to 0.07 solar masses and are close to the border between very late M stars and brown dwarfs. Comparisons have been attempted with theoretical luminosity functions (52.153.004), and with isochrones (54.115.001). Many uncertainties are still attached to the conclusions due to the problems on the exact distance modulus, the temperature scale and bolometric corrections, and the difference between the models. McDonald and Clarke (1993) examined the dynamics of binary star formation and its implication for brown dwarfs in binaries.

5.8 Space observations

IUE spectra of solar-type stars in the Pleiades have been obtained (54.153.082). Observations from the IRAS satellite are used to search for very late-type stars in clusters, study star-forming regions associated with nebulosity (56.153.015) and detect embedded clusters (Carpenter et al 1993; Pazstor et al 1993). ROSAT observations in the Hyades have been analysed by Stern et al (56.153.039). Several X-ray sources were also discovered in the old cluster M67 (Belloni et al 1993).

5.9 References

Belloni T., Verbunt F., Schmitt J.H.M.M. 1993, A&A 269, 175
Carpenter J.M., Snell R.L., Schloerb F.P., Skrutskie M.F. 1993, ApJ 407, 657
Friel E.D., Janes K.A. 1993, A&A 267, 75
Hamilton D., Stauffer J.R. 1993, AJ 105, 1855
Kaluzny J., Mazur B., Krzeminski W. 1993, MNRAS 262, 49
McDonald J.M., Clarke C.J. 1993, MNRAS 262, 800
Pasztor L., Toth L.V., Balasz L.G. 1993, A&A 268, 108

5.10 Cluster-by-cluster literature citations

The present compilation has been prepared from the literature cited in Astronomy and Astrophysics Abstracts, vol. 52 to 56 inclusive, and the published literature until June 1993. This compilation contains only papers published in journals, and not contributions in conferences. Photometric observations imply generally determination of reddenings, distances, and ages. These items are therefore not specified.

Glossary of abbreviations

abs = *absolute* **abund** = *abundance* **bin** = *binary*
act = *activity* **anal** = *analysis* **bd** = *brown dwarf*

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bs = *blue straggler*
ceph = *cepheid*
chem = *chemical*
chrom = *chromospheric*
cl = *classification*
col = *colour*
comp = *composition*
clus = *cluster*
CMD = *colour-magnitude diagram*
cont = *contact*
d = *distance*
diff = *differential*
distr = *distribution*
dyn = *dynamics*
eb = *eclipsing binary*
em = *emission*
en = *energy*
ex = *excess*
ext = *extinction*
form = *formation*
HH = *Herbig-Haro*
HRD = *HR diagram*
ident = *identification*
i/s = *interstellar*
imf = *initial mass function*
int = *integrated*
kinem = *kinematics*
lf = *luminosity function*
lm = *low mass*
mat = *matter*
meas = *measure*
mf = *mass function*
memb = *membership*
metal = *metallicity*
mm = *millimetric*
ms = *main sequence*
mod = *modulation*
monit = *monitoring*
obj = *object*
obs = *observation*
opt = *optical*
par = *parallaxe*
param = *parameter*
pe = *photoelectric*
per = *period*
pms = *pre-main-sequence*
pg = *photographic*
phot = *photometry*
plan neb = *planetary nebula*
pm = *proper motion*
pol = *polarization*
pos = *position*
red = *reddening*
rev = *review*
rg = *red giant*
rot = *rotation, rotational*
rv = *radial velocity*
sb = *spectroscopic binary*
sp = *spectral, -oscopic, -oscopy*
src = *source*
st = *star*
str = *strength*
struc = *structure*
temp = *temperature*
to = *turn off*
UV = *ultra-violet*
var = *variable*
vlm = *very low mass*
Wash = *Washington*
yso = *young stellar object*

C0000+671 (Be 59)
54.153.056 rv.
C0027+599 (NGC 129)
53.153.035 rv, rg.
56.153.006 UBV phot, sp cl, rv, rot.
C0039+850 (NGC 188)
52.153.011 sp abund.
52.153.062 BV phot, var st.
54.153.014 bin st form.
54.153.034 UBV pg phot.
55.153.005 age.
55.153.016 bs.
Meynet et al (1993) age.
C0040+615 (NGC 225)
54.153.036 UBV pg phot, sp cl, pm.
C0049+563 (NGC 281)
53.131.068 21cm survey.
C0048+579 (King 2)
52.153.021 UBVR CCD phot.
C0112+598 (NGC 433)
53.131.068 21cm survey.
55.153.014 UBV CCD phot.
C0112+585 (NGC 436)
53.153.009 UBV phot.
C0115+580 (NGC 457)
53.131.068 21cm survey.
54.153.056 rv.
54.153.077 pos.
Meynet et al (1993) age.
Fitzsimmons (1993) uvby CCD phot.
C0129+604 (NGC 581, M103)
54.153.056 rv.
54.153.077 pos.
Meynet et al (1993) age.
C0139+637 (NGC 637)
53.153.009 UBV phot.
54.153.056 rv.
C0140+616 (NGC 654)
54.153.056 rv.
Huestamendia et al (1993) UBV phot.
C0142+610 (NGC 663)
52.153.013 Hα em st.
54.153.079 uvby, JHK phot.
54.153.056 rv.
C0149+615 IC 166)
Friel & Janes (1993) rv, metal.
C0154+374 (NGC 752)
53.153.007 pm, memb.
55.002.129 pm, memb.
56.153.005 sp, iron abund.
Friel & Janes (1993) rv, metal.
Dzervitis & Paupers (1993) Vilnius phot.
Meynet et al (1993) age.
C0215+569 (NGC 869, h Per)
52.153.063 pos.
54.153.056 rv.
C2018+385 (Be 86)
55.153.012) UBV phot, CCD sp, WN st.
C0218+568 (NGC 884, chi Per)
52.153.063 pos.
54.153.056 rv.
Meynet et al (1993) age.
C2019+372 (Be 87)
52.153.028 sp anal, WR st.
54.153.054 opt sp, EXOSAT, X-ray.
C0230+573 (NGC 957)
54.153.056 rv.
54.153.073 UBV pg phot.
C0238+425 (NGC 1039, M34)
Ianna & Schlemmer (1993) pm, memb, UBV pg phot.
Meynet et al (1993) age.

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C0247+602 (IC 1848)
54.153.056 rv.
C0302+441 (NGC 1193)
Friel & Janes (1993) rv, metal.
C0318+484 (Alpha Persei, Mel 20)
55.115.012 sp, bd.
55.153.010 pm, rv, CCD phot, memb.
56.116.017 G dwarf activity.
56.153.007 rv, sb.
Meynet et al (1993) age.
O'Dell & Cameron (1993) rot mod, per.
C0328+371 (NGC 1342)
53.153.035 rv rg.
C0344+239 (Pleiades, Mel 22)
52.111.008 par.
52.122.145 sp obs, flare st.
52.126.028 EXOSAT, WD.
52.153.057 struct.
53.153.005 pm, memb, low mass st.
53.153.011 BVRI CCD phot, sp, Hα em str.
53.153.021 struct.
53.153.025 rot mod.
53.153.033 vlm st, bd, lf.
53.153.047 flare st.
53.153.065 IR search bd.
54.111.004 rv.
54.153.039 pm.
54.153.075 pm, vlm st, bd.
54.153.082 IUE obs, F5-G5 st.
55.115.014 IK CCD search, bd.
55.122.149 flare st, sp.
55.153.002 rv, corona st.
55.153.013 super clus.
56.153.016 rv, sb.
56.153.018 pm.
Hamilton & Stauffer (1993) sp, lm st.
Meynet et al (1993) age.
Prosser & Stauffer (1993) var st.
Soderblom et al (1993) rot, chrom act.
White & Bally (1993) IRAS, i/s mat distr.
C0403+622 (NGC 1502)
54.153.079 uvby, JHK phot.
55.153.011 uvby phot.
C0411+511 (NGC 1528)
53.153.035 rv rg.
C0417+501 (NGC 1545)
53.153.035 rv rg.
C0424+157 (Hyades, Mel 25)
52.114.086 OI abund, rg.
52.153.004 low mass st, imf.
52.153.014 par, pm.
52.153.032 HeI sp anal.
53.153.011 BVRI CCD phot, sp.
53.153.031 pm, d.
53.153.050 sp, chrom act, Hα em.
54.153.029 pm, Ap st.
54.153.055 par, d.
54.153.082 IUE obs, F5-G5 st.
54.153.007 HST obs, bin st.
55.114.010 chem comp, rg.
55.115.007 JHK phot, bd.
55.153.022 uvby phot.
56.153.010 WD, mass, memb.
56.153.012 super cl.
56.153.039 ROSAT X-ray obs.
Mason et al (1993) speckle obs.
Petersen et al (1993) rv, sb.
White et al (1993) radio survey.
C0443+189 (NGC 1647)
53.153.035 rv rg.
56.153.009 UBV phot, sp cl, rv, rot.
C0445+108 (NGC 1662)
53.153.035 rv rg.
C0447+436 (NGC 1664)
52.153.019 memb.
C0501+237 (NGC 1758)
56.153.045 Vilnius phot.
C0504+369 (NGC 1778)
54.153.056 rv.
C0509+166 (NGC 1817)
Friel & Janes (1993) rv, metal.
C0519+333 (NGC 1893)
54.153.079 uvby, JHK phot.
Rolleston et al (1993) chem comp.
Fitzsimmons (1993) uvby CCD phot.
C0524+352 (NGC 1907)
53.153.035 rv rg.
C0525+358 (NGC 1912, M38)
53.153.035 rv rg.
C0532-054 (Orion, Trapezium)
53.153.015 rv, sb.
54.153.081 rot mod, period.
56.121.075 rot per.
Duncan (1993) rot.
King (1993) Li abund.
Meaburn et al (1993) sp, jet, knot.
Meynet et al (1993) age.
Shevchenko & Yakubov (1993) UBVRI phot.
C0546+336 (Ki 8)
Friel & Janes (1993) rv, metal.
C0548+217 (Be 21)
Friel & Janes (1993) rv, metal.
C0549+325 (NGC 2099, M37)
53.153.035 rv rg.
C0551+003 (NGC 2112)
Friel & Janes (1993) rv, metal.
C0558+233 (NGC 2129)
54.153.056 rv.
C0600+104 (NGC 2141)
Friel & Janes (1993) rv, metal.
C0605+139 (NGC 2169)
54.153.056 rv.
Maitzen & Lebzelter (1993) phot, sp, Ap, var st.
C0605+243 (NGC 2168)
56.153.030 UBV phot.
C0613-186 (NGC 2204)
55.153.006 JHK phot, rg.
C0622+198 (Bo 1)
Fitzsimmons (1993) uvby CCD phot.
C0622+198 (Bo 2)
Rolleston et al (1993) chem comp.
C0627+068 (NGC 2236)
54.153.089 UBV pe pg phot.
C0627-312 (NGC 2243)
52.153.018 UBV CCD phot, age, metal.
55.153.006 JHK phot, rg.
53.153.030 BV CCD phot, lf.
Friel & Janes (1993) rv, metal.
C0629+049 (NGC 2244)
52.153.037 i/s ext.

52.153.053 memb, kinem.
53.153.078 radius, age, mass.
54.153.056 rv.

C0638+099 (NGC 2264)
52.153.002 memb.
52.153.053 memb, kinem.
52.153.064 pos.
53.153.078 radius, age, mass.
54.153.012 Walraven phot.
54.153.056 rv.
54.153.063 sp abund, temp, log g, rot.
56.121.029 HH obj.
Lada et al (1993) IR image.
Tauber et al (1993) st form.

C0640+270 (NGC 2266)
54.153.031 UBV, Wash CCD phot.

C0642+003 (Do 25)
52.153.022) sp abund.

C0645-031 (NGC 2286)
52.153.067 pm, memb.
55.153.048 BV pg phot.

C0644-206 (NGC 2287, M41)
54.153.056 rv.
56.154.032 Fe, Ca, Na, Al, O abund.
56.154.067 Vilnius phot.
Meynet et al (1993) age.

C0646+004 (Bo 2)
Turbide & Moffat (1993) UBV CCD phot.

C0649+005 (NGC 2301)
53.153.028 CMD, temp, log g.
56.153.038 memb.

C0655+065 (Be 32, Biu 8)
54.153.030 UBV, Wash CCD phot.
55.153.011 uvby phot.

C0700-082 (NGC 2323)
53.153.035 rv rg.

C0701+011 (NGC 2324)
56.153.011 Wash phot, rg
Marie (1993) memb.

C0701-207 (To 2)
56.153.049 var st, cont bin.
Friel & Janes (1993) rv, metal.

C0712-102 (NGC 2353)
52.153.047 UBV phot, sp cl.
53.153.035 rv rg.

C0714+138 (NGC 2355)
54.153.033 UBV CCD phot.
Meynet et al (1993) age.

C0715-155 (NGC 2360)
52.153.009 rv, rg.
56.153.011 Wash phot, rg
Friel & Janes (1993) rv, metal.
Meynet et al (1993) age.

C0716-248 (NGC 2362)
54.153.050 I CCD phot, lf.
55.153.015 lf, mf, lm, st, corona.

C0718-218 (NGC 2367)
54.153.056) rv.

C0722-209 (NGC 2384)
54.153.056 rv.

C0724-476 (Mel 66)
55.153.006 JHK phot, rg.
Friel & Janes (1993) rv, metal.

C0731-153 (NGC 2414)
54.153.056 rv.

C0735+216 (NGC 2420)
52.153.005 memb.
55.153.006 JHK phot, rg.
Friel & Janes (1993) rv, metal.

C0735-119 (Mel 71)
56.153.011 Wash phot, rg

C0734-205 (NGC 2421)
56.153.002 UBV CCD phot.

C0734-137 (NGC 2423)
52.153.009 rv, rg.

C0738-315 (NGC 2439)
56.153.002 UBV CCD phot.
Meynet et al (1993) age.

C0742-254 (Rup 32)
Turbide & Moffat (1993) UBV CCD phot.

C0744-044 (Be 39)
56.153.011 Wash phot, rg.
Friel & Janes (1993) rv, metal.
Kaluzny et al (1993) CCD phot, var st, bs.

C0750-261 (Haf 19)
56.153.019 BV, GR CCD phot, cal seq.

C0750-262 (Haf 18ab)
56.153.019 BV, GR CCD phot, cal seq.

C0750-384 (NGC 2477)
55.153.006 JHK phot, rg.
56.153.011 Wash phot, rg.
Friel & Janes (1993) rv, metal.

C0754-299 (NGC 2489)
56.153.002 UBV CCD phot.

C0757-106 (NGC 2506)
55.153.006 JHK phot, rg.
56.153.011 Wash phot, rg.
Friel & Janes (1993) rv, metal.

C0757-607 (NGC 2516)
55.153.055 flare st.
Meynet et al (1993) age.

C0816-304 (NGC 2567)
56.153.002 UBV CCD phot.

C0835-297 (NGC 2627)
56.153.002 UBV CCD phot.

C0837+201 (NGC 2632, M44, Praesepe)
52.153.006 UBVRI phot, rv, corona st.
52.153.057 struct.
53.153.021 struct.
54.041.023 pos.
54.153.004 uvby phot.
54.153.017 rv, sb.
54.153.053 pm, memb, BV pg phot.
55.153.018 iron abund.
56.123.015 flare st.
Breger et al (1993) phot, var st.
Vidal et al (1993) CCD phot, var st.

C0838-528 (IC 2391)
54.153.071 memb, super clus.
55.153.055 flare st.

C0840-469 (NGC 2660)
55.153.006 JHK phot, rg.
56.153.011 Wash phot, rg.

C0841-324 (NGC 2658)
56.153.002 UBV CCD phot.

C0847+120 (NGC 2682, M67)
52.113.016 uvby CCD phot.
52.113.038 VRIc phot.
52.153.020 rv, sb, orb.
52.153.055 struct.

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53.153.002 UBV CCD phot, var st, cont bin.
53.153.022 rv.
53.153.037 sp, abund, bs.
53.153.042 sp, rg, C isotope.
53.153.045 sp, bs, Li abund.
54.153.006 BVRIc CCD phot.
54.153.027 JHK phot, bs.
54.153.052 metal, temp, to st.
55.153.005 age.
55.153.006 JHK phot, rg.
55.153.016 bs.
55.153.017 CCD phot, var st, bs.
55.153.018 iron abund.
56.153.056 pm.
56.153.068 VRI CCD phot.
Belloni et al (1993) ROSAT X-ray src.
Friel & Janes (1993) rv, metal.
Meynet et al (1993) age.
Montgomery et al (1993) CCD phot.

C0914-364 (NGC 2818)
56.153.011 Wash phot, rg.

C0928-526 (NGC 2910)
56.153.002 UBV CCD phot.

C1001-598 (NGC 3114)
53.153.039 BV CCD phot, sp cl, rv.

C1022-575 (Wes 2)
54.153.049 UBV phot, sp cl, WN st.

C1028-595 (Cr 223)
54.153.028 UBV phot, DDO rg.

C1033-579 (NGC 3293)
56.122.035 uvby phot, var st.

C1036-589 (vdBH 99)
52.153.010 UBV, uvby phot, sp cl.

C1041-593 (Tr 14)
54.153.016 rv, sb.
Cudworth et al (1993) pm, memb, ubv pg phot.
Massey & Johnson (1993) UBV CCD phot, sp cl.
Penny et al (1993) rv.

C1041-641 (IC 2602)
55.153.055 flare st.

C1043-594 (Tr 16)
53.153.026 rv, sb.
Cudworth et al (1993) pm, memb, ubv pg phot.
Kaltcheva & Georgiev (1993) uvby phot.
Massey & Johnson (1993) UBV CCD phot, sp cl.

C1104-584 (NGC 3532)
Meynet et al (1993) age.

C1058-601 (Sher 1)
54.153.049 UBV phot, sp cl, WN st.

C1108-599 (NGC 3572)
53.134.028 plan neb.

C1109-604 (Tr 18)
52.153.022 UBVRI phot.

C1112-609 (NGC 3603)
Santos & Bica (1993) int sp, red, age

C1117-632 (Mel 105)
53.153.008 UBV CCD phot.
Santos & Bica (1993) int sp, red, age

C1123-429 (NGC 3680)
54.153.051 BV pg, CCD phot.
Friel & Janes (1993) rv, metal.

C1133-613 (NGC 3766)
54.112.096 Be st, light curve.

C1148-554 (NGC 3960)
56.153.011 Wash phot, rg.
Friel & Janes (1993) rv, metal.

C1222+263 (Coma Ber)
52.153.057 struct.
53.153.021 struct.
53.153.035 rv rg.
55.153.018 iron abund.
56.153.001 imf.
Bounatiro & Arimoto (1993) imf

C1250-600 (NGC 4755)
53.153.008 UBV CCD phot.
Santos & Bica (1993) int sp, red, age.
Meynet et al (1993) age.

C1254-646 (NGC 4815)
53.153.008 UBV CCD phot.

C1326-609 (Ho 16)
54.153.008 UBVRIc phot.

C1327-606 (NGC 5168)
53.153.008 UBV CCD phot.

C1404-480 (NGC 5460)
Meynet et al (1993) age.
Claria et al (1993) UBV phot.

C1424-594 (NGC 5606)
53.153.012 UBVRI phot.

C1426-605 (NGC 5617)
53.153.008 UBV CCD phot.
Santos & Bica (1993) int sp, red, age

C1431-563 (NGC 5662)
53.153.034 UBV phot.
Meynet et al (1993) age.

C1445-543 (NGC 5749)
56.153.067 UBV phot.

C1501-541 (NGC 5822)
52.153.009 rv, rg.
Friel & Janes (1993) rv, metal.
Twarog et al (1993) UBV pe, pg, DDO phot.

C1548-563 (NGC 5999)
Santos & Bica (1993) int sp, red, age

C1559-603 (NGC 6025)
Meynet et al (1993) age.

C1609-540 (NGC 6067)
Santos & Bica (1993) int sp, red, age
Meynet et al (1993) age.

C1614-577 (NGC 6087)
Meynet et al (1993) age.

C1624-490 (NGC 6134)
53.153.008 UBV CCD phot.
56.153.028 UBV, DDO, rv, rg.

C1636-432 (NGC 6192)
53.153.008 UBV CCD phot.

C1637-486 (NGC 6193)
55.153.024 UBVRI phot, col ex.

C1642-469 (NGC 6204)
53.153.008 UBV CCD phot.

C1650-417 (NGC 6231)
52.152.004 UBV phot, sp cl, rv.
55.152.007 lf.
54.153.005 param.
Meynet et al (1993) age.
Santos & Bica (1993) int sp, red, age

C1652-394 (NGC 6242)
Meynet et al (1993) age.

C1720-499 (IC 4651)
53.153.008 UBV CCD phot.
Meynet et al (1993) age.

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C1743+057 (IC 4665)
54.153.037 rv, sb.
C1747-302 (NGC 6451)
53.153.008 UBV CCD phot.
C1750-348 (NGC 6475)
Meynet et al (1993) age.
C1753-190 (NGC 6494, M23)
52.153.003 UBV phot.
Meynet et al (1993) age.
C1800-279 (NGC 6520)
53.153.008 UBV CCD phot.
Santos & Bica (1993) int sp, red, age
C1815-184 (NGC 6603)
Bica et al (1993) UBV CCD phot.
Santos & Bica (1993) int sp, red, age
C1815-122 (NGC 6604)
54.153.056 rv.
C1816-138 (NGC 6611, M16)
56.153.015 IR src clus.
Santos & Bica (1993) int sp, red, age
C1816-138 (NGC 6618, M17)
53.132.051 JHK survey, emb src, yso.
C1825+065 (NGC 6633)
53.153.035 rv, rg.
54.153.027 JHK phot, bs.
C1830-104 (NGC 6649)
Berdnikov (1992) cep var, light curve.
C1836+054 (IC 4756)
52.153.009 rv, rg.
52.153.043 rv, rg.
C1848-063 (NGC 6705, M11)
53.153.008 UBV CCD phot.
56.153.046 Vilnius phot.
Brocato et al (1993) BV CCD phot, lf.
Meynet et al (1993) age.
Zakirov (1993) close bin, eb.
C1851-199 (NGC 6716)
52.153.048 UBV pe pg phot.
C1902+018 (Be 42)
53.153.040 UBVR CCD phot.
C1905+041(NGC 6755)
53.153.008 UBV CCD phot.
C1906+046 (NGC 6756)
Santos & Bica (1993) int sp, red, age
C1919+377 (NGC 6791)
55.153.004 BVI CCD phot, bs.
55.153.005 age.
Friel & Janes (1993) rv, metal.
Meynet et al (1993) age.
C1941+231 (NGC 6823)
52.153.037 i/s ext.
55.153.008 UBV pe, CCD phot.
56.153.003 memb, lf, cl mass.
C1936+464 (NGC 6811)
52.153.009 rv, rg.
C1939+400 (NGC 6819)
54.153.027 JHK phot, bs.
Friel & Janes (1993) rv, metal.
C1956+203 (Ros 3)
Turner (1993) UBV phot, sp cl, rv, Vsini.
C2004+356 (NGC 6871)
54.153.027 JHK phot, bs.
56.119.057 close bin, eb, phot.
C2008+410 (IC 1311)
55.153.009 BVR CCD phot.
C2009+263 (NGC 6882/5)
52.123.015 var st.
C2017+379 (Do 42)
52.153.044 UBVR phot, eb.
C2021+406 (NGC 6910)
53.131.319 UBVR phot, Hα em st.
54.153.027 JHK phot, bs.
56.153.044 Vilnius phot.
C2022+383 (NGC 6913, M29)
52.153.002 memb.
53.153.035 rv rg.
52.153.037 i/s ext.
54.153.056 rv.
52.153.053 memb, kinem.
C2030+604 (NGC 6939)
53.153.036 pm, rv, rg.
54.153.027 JHK phot, bs.
C2054+444 (NGC 6996)
52.153.050 Vilnius phot.
C2121+461 (NGC 7062)
52.153.065 uvby phot.
C2130+482 (NGC 7092, M39)
53.153.013 JHK phot.
56.154.030 UIT image.
Glushkova (1992) pm.
C2137+572 (Tr 37)
53.153.071 pm, memb.
C2144+655 (NGC 7142)
53.153.041 BV CCD phot.
54.123.011 var st.
Friel & Janes (1993) rv, metal.
C2151+470 (IC 5146)
54.153.056 rv.
C2152+623 (NGC 7160)
54.153.056 rv.
C2203+462 (NGC 7209)
53.153.014 pm, memb.
55.002.130 pm, memb.
C2220+556 (Be 94)
Fitzsimmons (1993) uvby CCD phot.
C2309+603 (NGC 7510)
53.153.038 BVI CCD phot.
C2322+613 (NGC 7654, M52)
52.153.049 uvby pg phot.
C2345+683 (King 11)
53.153.040 UBVR CCD phot.
C2354+564 (NGC 7789)
52.153.068 pol, memb.
54.153.027 JHK phot, bs.
Friel & Janes (1993) rv, metal.
C2355+609 (NGC 7790)
52.118.023 light curve ceph.
56.002.048 rv, ceph var.

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6 Globular clusters

6.1 Review papers

It is difficult to summarize the numerous results obtained in all the domains relating to galactic globular cluster research and published in more than 800 papers. Instead the present paragraph lists review papers covering several domains and the interested reader is asked to look at them for a presentation of the scientific achievement of the past years.

Many contributions on globular clusters can be found in the conference on "Formation and evolution of star clusters" representing most fields of present research on these objects. An interesting summary of some topics discussed at the 1992 Santa Cruz summer workshop and at the conference on "Dynamics of globular clusters" has been presented by Trimble (1993).

Recent observations have shown that globular clusters contain a significant binary population, a dramatic change from the conventional view of even a decade ago. A comprehensive review of the subject is

presented by Hut et al (56.154.056). Fusi Pecci et al (56.154.014) have reviewed the current status of the search and study of blue stragglers in galactic globular clusters and produced a catalogue of 425 candidate blue stragglers in 21 clusters.
Main sequence mass functions in globular clusters are of importance for the insight they provide into a number of astrophysical problems and are discussed by Richer & Fahlman (54.154.048). Techniques involved in deriving luminosity function from CCD observations are reviewed by Stetson (54.154.046).
The general subject of globular clusters as tests of stellar evolution has been comprehensively reviewed by Hesser (54.154.146). He addresses the spectroscopic tests of mixing within globular cluster stars and topics related to the colour-magnitude diagrams (binarity, blue stragglers, luminosity function), stellar evolution and cluster ages. Recent advances in the understanding of horizontal-branch stars are discussed by Lee (54.154.053), with special emphasis on the second parameter problem. Djorgovski (54.154.047) showed from the results of a multivariate statistical analysis that at least 4 (possibly 5 or 6) parameters are neded in order to fully describe the global properties of globular clusters.
The ages of globular clusters and sources of uncertainties are reviewed by Demarque et al (54.154.140). Advances in precision photometry and in the modelling of turnoffs indicate that the spread in age is at least 4 Gyr among galactic globular clusters. An approximate chronology of the Galaxy is presented on the basis of the current best understanding of cluster dating. The lowest age derived for NGC 6341 (M92) is 14 Gyr.
Some recent work on CNO abundances and $^{12}C/^{13}C$ ratios has been reviewed by Bell (54.154.111). It is necessary to know cluster oxygen abundance, because the location of the isochrones in the theoretical HR diagram also depends on it. Carbon isotopic abundances determined for 45 red giants in NGC 6121 and 6752 indicate that these low-mass, low-metallicity giants have undergone extensive mixing of their outer envelope with material processed through the CN cycle (54.154.133).
Absolute proper motions and space velocities for 14 clusters have been computed (Cudworth & Hanson 1993).

6.2 Selected highlights

A selection of observational facts is presented below. It can neither be exhaustive nor cover all aspects. I apologize for the missing references to important results not quoted here. Pleases refer to chapter 154 of the Astronomy and Astrophysics Abstracts for further bibliography.

Cudworth K.M., Hanson R.B. 1993, AJ 105, 168
Trimble V. 1993, Comments Astrophys. 16, 363 (no 6)

6.2.1 CCD photometry

As shown by the tabulation of globular cluster observations presented below, 74 globular clusters have received attention during this period. CCD photometry in various filter combinations (BV, BVI, UBVRI) was published for 39 clusters. These studies often present data for several thousand stars either to improved the morphology of the colour-magnitude diagrams or to determine the faint star luminosity function. These extensive studies have permitted to discover and observe many variable stars and blue stragglers. A radial distribution study of blue subdwarfs in ω Centauri based on CCD photometry showed that the blue subdwarfs are centrally concentrated with respect to subgiants and horizontal branch stars (55.154.022)

6.2.2 Binary stars

The analysis of the main-sequence width, based on high-quality CCD photometry, provided an estimate of the fraction of binaries ($\sim$ 8%) showing a sizeable effect of duplicity in the colour-magnitude diagram (53.154.036). A value of 10% photometric binaries has been observed in NGC 288 (56.154.072). Centrally condensed binaries have been invoked to explain the colour gradient found in clusters with central cusp (53.154.032). This result has been contested (55.154.012). Two possible causes of the observed colour gradient may be (1) a centrally concentrated population of faint blue stars, (2) a central deficiency of low-mass main-sequence stars. Two eclipsing binaries were found in NGC 6838 (M71) (54.154.076).

6.2.3 Blue stragglers

Among the interesting objects, one may notice the six SX Phe variables and three eclipsing binaries discovered among the blue stragglers in NGC 5466 (52.154.018). A significant population of blue stragglers has been found in NGC 6101 and shown to be more concentrated towards the cluster centre than subgiants of similar magnitude (54.154.055). Two variable blue stragglers were found in NGC 6838 (M71) (54.154.076).

6.2.4 Distances, ages and diameters

Very accurate relative distances have been obtained from the (log Period, infrared magnitude) relation of RR Lyrae variables (52.154.050).
A method based on direct superimposition of colour-magnitude diagrams has been proposed (52.154.017) to measure age difference among clusters with a similar metallicity. CCD photometry of Ruprecht 106 has shown that this cluster may be 4-5 billion years younger (52.154.030), a result confirmed by subsequent study (56.154.003).
The diameters of 98 cluster are found to correlate with the galactocentric distances, but not with luminosity (mass) or metallicity (54.154.003).

6.2.5 Luminosity function

The "bump" in the differential luminosity function of red giants, which arises as evolution up the red giant branch pauses, has been identified in 11 clusters and the variation with metallicity and age investigated (52.154.026). The dependence of the mass function slopes on physical parameters has been examined for a sample of 14 clusters with deep CCD luminosity functions. A consequence of the analysis is that a correction for the selective mass loss at the tidal radius must be applied to present-day mass functions (53.154.020). Richer et al (54.154.132) found that cluster evolution has been important in modifying the mass function in NGC 6397 and 6838.

6.2.6 X-ray and radio sources, pulsars

Radio counterparts of X-ray sources were identified in NGC 6712 (52.154.033), NGC 6712 and 7078 (52.154.044), NGC 6624 (56.154.002). A hard X-ray source has been discovered in the direction of the cluster Terzan 2 (54.154.101).
Ten additional millisecond pulsars were found in NGC 104 (47 Tuc) (54.154.135). Half of them are members of binary systems. Millisecond pulsars have now been found in 12 globular clusters during the four past years, and almost half of them reside in 47 Tuc.

6.2.7 Space observations

U-band PC HST images of the M15 core have been obtained and show a large core with $r_c = 2.2$ arcsec. This dimension may reflect postcollapse expansion (53.154.015). Far-ultraviolet images for NGC 1904 (56.154.029) and NGC 5139, 5272 and 6205 (56.154.030) were obtained with the Ultraviolet Imaging Telescope and allowed a complete identification of UV-bright objects in these clusters. Four clusters have been imaged at 2000 Å with a balloon-born telescope (55.154.048). High-resolution observations of the core of 47 Tuc with the FOC on the HST reveal a high density of "blue straggler" stars (54.154.138). Their presence in the dense core supports the hypothesis of their binary origin.

6.3 Cluster-by-cluster literature citations

Abbreviations specific to globular clusters

astr = *astrometry, -ic*
bhb = *blue horizontal branch*
B-W = *Baade-Wesselink*
col = *colour*
comp = *comparaison*
dens = *density*
detec = *detection*
FOC = *faint object camera*
fr = *frame*
gal mot = *galactic motion*
gal orb = *galactic orbit*
glob = *globular*
grad = *gradient*
high vel = *high velocity*
HST = *Hubble Space telescope*
id = *identification*
lin pol = *linear polarisation*
m/l = *mass-luminosity*
mod = *model*
morph = *morphology*
orig = *origin*

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PC = *planetary camera*
prof = *profile*
prop = *property*
rad = *radial*
ref = *reference*
rgb = *red giant branch*
sd = *subdwarf*
segr = *segregation*
smr = *super metal-rich*
sp vel = *space velocity*
spat str = *spatial structure*
st cont = *stellar content*
surf phot = *surface photometry*
vel disp = *velocity dispersion*

C0021-723 (NGC 104, 47 Tuc)
52.154.006 VIc phot, rgb.
52.154.008 CO band obs, rg.
52.154.021 rad col grad.
52.154.025 C,N,O,Fe abund.
53.154.004 CaII str, abund.
53.154.039 C,N, abund, ms st.
54.154.027 VI CCD phot, rgb, metal.
54.154.125 Mg, Na abund, rg.
54.154.138 HST FOC obs, bs.
54.154.155 2 high vel st.
55.154.042 rel pm, memb.
56.154.012 HST PC obs, core.
56.154.013 CCD sp, abund.
56.154.016 memb, UV-bright st, "BS".
56.154.088 HST PC obs, X-ray src.
56.114.013 CN str, rg.
56.156.007 sp, rv, metal.
Carney et al (1993) BV phot, RR Lyr var.
Cudworth & Hanson (1993) abs pm, sp vel.
Rich et al (1993) IUE int sp.

C0050-268 (NGC 288)
52.154.053 age.
54.154.067 m/l ratio.
54.154.068 mod, abund, rgb.
56.154.072 BV CCD phot, bs, ms bin.
56.156.007 sp, rv, metal.
Guo et al (1993) abs pm, sp vel.

C0100-711 (NGC 362)
52.154.053 age.
54.154.068 mod, abund, rgb.
54.154.124 abs pm.
55.154.043 rel pm, memb.
Rich et al (1993) IUE int sp.

C0310-554 (NGC 1261)
56.154.015 BVR CCD phot.

C0512-400 (NGC 1851)
52.154.006 VIc phot, rgb.
52.154.043 VLA image.
53.154.004 CaII str, abund.
56.154.038 BV CCD phot.

C0522-245 (NGC 1904, M79)
55.154.054 BV CCD phot, metal, bs.
56.114.013 CN str, rg.
56.154.029 UIT image.
56.156.007 sp, rv, metal.

C0647-359 (NGC 2298)
53.154.006 search for RR Lyr var.
56.154.010 Wash phot, rg.
56.154.039 CCD sp, abund, Fe/H.

C0734+390 (NGC 2419)
54.154.021 BVI CCD surf phot.
56.114.013 CN str, rg.

C0911-646 (NGC 2808)
52.154.003 BV CCD phot.
53.154.040 21cm obs.

C1003+003 (Pal 3)
56.154.004 sp, CaII, abund, rg.

C1015-461 (NGC 3201)
Brewer et al (1993) UBVI CCD phot, bs.

C1126+292 (Pal 4)
56.154.004 sp, CaII, abund, rg.

C1207+188 (NGC 4147)
53.154.021 BV CCD phot.
55.154.007 abs pm, gal orb.
55.154.019 IR col prof.
56.114.013 CN str, rg.
56.154.004 sp, CaII, abund, rg.

C1223-724 (NGC 4372)
54.154.044 BVRI CCD phot.
55.154.016 lin pol, rg.
56.154.010 Wash phot, rg.

C1235-509 (Rup 106)
52.154.030 UBV CCD phot, bs.
54.153.032 BVI CCD phot.
55.154.032 young glob clus.
56.154.003 metal, age.
Buonanno et al (1993) comp mod, age.

C1236-264 (NGC 4590)
56.154.010 Wash phot, rg.

C1256-706 (NGC 4833)
55.154.016 lin pol, rg.
56.154.010 Wash phot, rg.

C1310+184 (NGC 5024)
53.126.036 new pulsar.
53.154.002 CCD phot.

C1313+179 (NGC 5053)
53.154.002 CCD phot.
54.154.065 orig bs.
54.154.128 CCD phot, struct.
56.114.013 CN str, rg.
56.154.004 sp, CaII, abund, rg.

C1323-472 (NGC 5139, Omega Cen)
52.154.031 RR Lyr var.
52.154.034 RR Lyr var.
52.154.047 CNO abund, rg.
53.154.022 CCD phot, ms st.
54.154.026 O, Fe abund, rg.
54.154.132 I CCD image, mf.
55.154.016 lin pol, rg.
55.154.022 rad distr, blue sd st.
56.154.007 CNO abund.
56.154.009 uvby CCD phot, ms st.
56.154.029 UIT image.

C1339+286 (NGC 5272, M3)
52.123.005 obs var st.
52.123.007 obs var st.
52.123.009 obs var st.
52.154.012 depp CCD phot.
52.154.046 VLA image.
52.154.062 astr ref st.
53.123.003 obs var st.
54.123.024 obs var st.
54.123.030 obs var st.
54.154.127 rv, vel disp.

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55.154.005 IUE obs, UV st.
55.154.006 dens prof, lf.
55.154.048 UV image, bhb st distr.
55.154.057 abs pm.
56.154.030 UIT, IUE obs, UV-bright st.
56.155.014 O, Na, Va, Sc abund, rg.
Cudworth & Hanson (1993) abs pm, sp vel.

C1403+287 (NGC 5466)
52.154.018 CCD phot, bs, eb, var st.
54.154.067 m/l ratio.

C1452-820 (IC 4499)
Sarajedini (1993) BV CCD phot, bs.

C1514-208 (NGC 5897)
55.154.053 UBVI CCD phot, bs.
56.154.005 BV CCD phot, bs.
56.154.010 Wash phot, rg.

C1516+022 (NGC 5904, M5)
52.154.062 astr ref st.
54.154.126 BV CCD phot, RR Lyr var.
54.154.127 rv, vel disp.
54.154.132 I CCD image, mf.
55.122.014 K phot, RR Lyr var.
55.122.015 rv curve, RR Lyr var.
55.154.013 new var st.
55.154.028 sp, CN, CH band str.
55.154.048 UV image, bhb st distr.
56.114.013 CN str, rg.
56.122.126 B-W, RR Lyr var.
56.154.001 B pg phot, RR Lyr var, per.
56.154.004 sp, CaII, abund, rg.
56.154.021 O, Na, Fe abund, rg.
56.154.037 B pg phot, RR Lyr st, per.
56.154.040 Vi, JK phot, RR Lyr var.
Cudworth & Hanson (1993) abs pm, sp vel.
Smith & Norris (1993) sp, CN str, AGB.

C1524-505 (NGC 5927)
53.154.005 Wash phot.
56.154.057 BV pg phot, red.

C1531-504 (NGC 5946)
54.154.072 BV CCD phot.

C1608+150 (Pal 14)
55.154.008 deep BV CCD phot.
56.154.004 sp, CaII, abund, rg.

C1614-228 (NGC 6093, M80)
53.154.006 search for RR Lyr var.
56.154.020 IUE UV obs, col grad.

C1620-264 (NGC 6121, M4)
52.154.025 C,N,O,Fe abund.
52.154.046 VLA image, point src, pulsar.
54.154.127 rv, vel disp.
55.154.016 lin pol, rg.
56.154.004 sp, CaII, abund, rg.
56.154.013 CCD sp, abund.
56.154.032 Na, Al, O abund, rg.
Cudworth & Hanson (1993) abs pm, sp vel.
Smith & Norris (1993) sp, CN str, AGB.

C1620-720 (NGC 6101)
56.154.010 Wash phot, rg.

C1624-387 (NGC 6139)
53.154.001 phot, var st, RR Lyr.

C1629-129 (NGC 6171, M107)
52.154.048 spat str.
54.154.142 BV CCD phot.
55.154.018 BV pg phot, pm, memb.
55.154.038 deep BV CCD phot, lf.
56.154.004 sp, CaII, abund, rg.
Cudworth & Hanson (1993) abs pm, sp vel.

C1639+365 (NGC 6205, M13)
52.154.027 CCD phot, lf.
52.154.062 astr ref st.
53.154.009 C,N,O abund, rg.
53.154.014 Ca,Na,Fe abund, rg.
53.126.036 new pulsar.
54.154.127 rv, vel disp.
55.154.048 UV image, bhb st distr.
56.114.013 CN str, rg.
56.154.004 sp, CaII, abund, rg.
56.154.019 mass, st cont.
56.154.030 UIT, IUE obs, UV-bright st.
56.154.034 K phot, d.
56.155.014 O,Na,Va,Sc abund, rg.
Cudworth & Hanson (1993) abs pm, sp vel.

C1644-018 (NGC 6218)
54.154.039 pos, pm, UV st.
54.154.124 abs pm.
54.154.127 rv, vel disp.
55.154.007 abs pm, gal orb.

C1645+476 (NGC 6229)
53.154.010 BV CCD phot.

C1654-040 (NGC 6254, M10)
52.154.041 IR phot, i/s ext, d.
53.154.026 IR phot, rg.
54.154.127 rv, vel disp.

C1657-004 (Pal 15)
54.154.070 BV CCD phot.

C1658-300 (NGC 6266)
55.154.016 lin pol, rg.

C1707-265 (NGC 6293)
53.154.016 BV CCD phot.

C1711-294 (NGC 6304)
56.154.071 VK image, rg, HB st.

C1713-280 (NGC 6316)
56.154.071 VK image, rg, HB st.

C1716-184 (NGC 6333, M9)
53.154.006 search for RR Lyr var.
53.154.016 BV CCD phot.

C1715+432 (NGC 6341, M92)
52.154.007 lf, turn off st.
52.154.046 VLA image.
53.154.036 bin freq.
55.122.011 BV CCD phot, RR Lyr var.
55.122.014 K phot, RR Lyr var.
55.122.015 rv curve, RR Lyr var.
55.154.006 dens prof, lf.
55.154.023 BV pg phot, pm, sp vel.
55.154.048 UV image, bhb st distr.
56.114.013 CN str, rg.
56.122.126 B-W, RR Lyr var.
56.154.004 sp, CaII, abund, rg.
56.154.040 Vi, JK phot, RR Lyr var.
56.154.067 Vilnius phot.
Cudworth & Hanson (1993) abs pm, sp vel.

C1720-263 (NGC 6356)
54.154.027 VI CCD phot, rgb, metal.
Rich et al (1993) IUE int sp.

C1721-484 (NGC 6352)
Rich et al (1993) IUE int sp.

C1724-307 (Terzan 2)
54.154.101 X-ray src.
55.154.009 IR phot, rgb.

56.142.088 SIGMA obs, X-ray src.

C1732-304 (Terzan 1)
54.154.027 VI CCD phot, rgb, metal.
Ortolani et al (1993) BVRIz CCD phot.

C1732-447 (NGC 6388)
Rich et al (1993) IUE int sp.

C1736-536 (NGC 6397)
52.154.006 VIc phot, rgb.
52.154.022 G-band str.
53.154.004 CaII str, abund.
54.154.029 rv, vel disp, dyn.
55.154.020 uvby CCD phot, bin det.
56.114.022 near IR sp, rg.
56.154.008 rad distr bs, surf bright.
56.154.010 Wash phot, rg.
Cudworth & Hanson (1993) abs pm, sp vel.

C1735-032 (NGC 6402, M14)
53.154.017 HST FOC U,B image, Nova Oph 1938.

C1745-247 (Terzan 5)
52.126.043 eclipsing pulsar.
52.126.045 eclipsing pulsar.
53.117.135 bin MSP.

C1746-370 (NGC 6441)
Rich et al (1993) IUE int sp.

C1747-312 (Terzan 6)
53.154.023 ROSAT X-ray src.

C1755-442 (NGC 6496)
53.154.005 Wash phot.
Rich et al (1993) IUE int sp.

C1801-300 (NGC 6528)
54.154.027 VI CCD phot, rgb, metal.
55.154.041 deep BVRI CCD phot.
Rich et al (1993) IUE int sp.

C1806-259 (NGC 6553)
52.154.015 BVRI CCD phot.
54.154.027 VI CCD phot, rgb, metal.
55.154.049 sp 1 st, metal abund.
56.154.022 clump morph, age.

C1820-303 (NGC 6624)
52.154.043 VLA image.
55.154.040 CCD fr, pol, ext, dust.
55.154.052 mod, dyn, vel disp.
56.154.002 deep VLA image.
Rich et al (1993) IUE int sp.

C1821-249 (NGC 6626, M28)
52.122.082 post-AGB st.
52.154.019 BV pg phot, var st.
52.154.046 VLA image, point src, pulsar.
54.154.043 BV pg phot, pm.
Cudworth & Hanson (1993) abs pm, sp vel.
Rich et al (1993) IUE int sp.

C1828-323 (NGC 6637)
53.154.011 JHK phot.
Rich et al (1993) IUE int sp.

C1828-235 (NGC 6642)
Hazen (1993) phot, new var st, RR Lyr.

C1832-330 (NGC 6652)
53.154.023 ROSAT X-ray src.

C1833-239 (NGC 6656, M22)
52.134.035 neb plan.
52.154.016 i/s pol.
52.154.025 C,N,O,Fe abund.
52.154.035 i/s, st line prof.
53.154.014 Ca,Na,Fe abund, rg.
54.134.053 mod neb plan.
54.154.125 Mg,Na abund, rg.
55.154.016 lin pol, rg.
56.114.038 abund, CH st.
56.131.077 radio, IRAS obs, i/s mat.
56.154.013 CCD sp, abund.
56.154.067 Vilnius phot.
Cudworth & Hanson (1993) abs pm, sp vel.

C1850-087 (NGC 6712)
52.154.033 X-ray bin, opt id.
52.154.039 radio em, X-ray src.
52.154.043 VLA image, radio id.
52.154.045 gal mot.
56.154.011 UBV CCD phot, sp.
Cudworth & Hanson (1993) abs pm, sp vel.

C1906-600 (NGC 6752)
52.154.006 VIc phot, rgb.
52.154.038 rg, chrom act.
52.154.056 UV survey, IUE, hot st.
53.154.004 CaII str, abund.
54.154.125 Mg,Na abund, rg.
54.154.132 I CCD image, mf.
56.114.013 CN str, rg.
56.154.020 IUE UV obs, col grad.
Smith & Norris (1993) sp, CN str, AGB.

C1936-310 (NGC 6809, M55)
52.154.022 G-band str.
54.154.067 m/l ratio.
56.154.006 BVRI CCD phot.
56.154.010 Wash phot, rg.
56.154.021 abund.

C1942-081 (Pal 11)
56.154.004 sp, CaII, abund, rg.

C1951+186 (NGC 6838, M71)
52.154.027 CCD phot, lf.
54.154.127 rv, vel disp.
55.154.010 deep BV CCD phot.
55.154.014 test mod, dens prof, mf.
56.154.004 sp, CaII, abund, rg.
56.154.031 CN, CH str.
56.113.012 CCD Vilnius phot, i/s red.
56.154.067 Vilnius phot.
Cudworth & Hanson (1993) abs pm, sp vel.

C2059+160 (NGC 7006)
54.154.066 BV CCD phot.

C2127+119 (NGC 7078, M15)
52.154.006 VIc phot, rgb.
52.126.021 radio pulsar.
52.142.041 X-ray burst.
52.154.031 RR Lyr var.
52.154.043 VLA image, radio id.
52.154.046 VLA image, point src, pulsar.
53.126.051 pulsar obs.
53.154.004 CaII str, abund.
53.154.015 HST PC core image.
53.154.029 CaII em, bin st.
54.154.020 lf.
55.154.012 col grad.
55.154.025 mod, evol RR Lyr var.
55.154.052 mod, dyn, vel disp.
56.114.013 CN str, rg.
56.122.135 K1082, new type, var st.
56.154.010 Wash phot, rg.
56.154.026 pos, pm.
56.154.068 Vilnius phot, i/s red.
Cudworth & Hanson (1993) abs pm, sp vel.

Durrell & Harris (1993) BCV CCD phot, lf.

C2130-010 (NGC 7089, M2)
52.154.006 VIc phot, rgb.
53.154.004 CaII str, abund.
56.114.013 CN str, rg.
Cudworth & Hanson (1993) abs pm, sp vel.

C2137-234 (NGC 7099, M30)
53.154.036 bin freq.
56.114.013 CN str, rg.
56.154.010 Wash phot, rg.
56.154.020 IUE UV obs, col grad.
56.154.023 vel disp.
56.156.007 sp, rv, metal.

C2143-214 (Pal 12)
52.154.006 VIc phot, rgb.

C2305-159 (NGC 7492)
54.154.071 BV phot, bs, mass segr.

6.4 References to 1993 papers on globular clusters

Brewer J.P., Fahlman G.G., Richer H.B., et al 1993, AJ 105, 2158
Buonanno R., Corsi C.E., Fusi Pecci F.F., et al 1993, AJ 105, 184
Carney B.W., Storm J., Williams C. 1993, PASP 105, 294
Cudworth K.M., Hanson R.B. 1993, AJ 105, 168
Durrell P.R., Harris W.E. 1993, AJ 105, 1420
Guo X., Girard T.M., van Altena W.F., Lopez C.E. 1993, AJ 105, 2182
Hazen M.L. 1993, AJ 105, 557
Ortolani S., Bica E., Barbuy B. 1993, A&A 267, 66
Rich R.M., Minniti D., Liebert J. 1993, ApJ 406, 489
Sarajedini A. 1993, AJ 105, 2172
Smith G.H., Norris J.E. 1993, AJ 105, 173

7 Magellanic Cloud clusters

7.1 Large Magellanic Cloud clusters

A new catalogue of 1762 clusters in the Large Magellanic Cloud based on the ESO/SERC Southern Sky Atlas has been constructed by Kontizas et al (52.156.002). Bhatia et al (53.156.092) prepared a catalogue of 64 pairs of clusters. They give accurate coordinates and a photographic atlas. van den Bergh (53.156.133) summarized the properties of Magellanic Cloud clusters. They differ from those in the Galaxy in a number of important respects (radii, ellipticity, population size). Chiosi (53.156.158) discusses the main properties of the family of star clusters in the LMC. Walborn (53.156.033) presented a review of the stellar population and current observing programmes on the 30 Doradus region which is the region of the LMC which is now subjected to many studies, especially from space (X-ray, IR, HST). As depicted by the literature survey summarized in section 7.3, CCD photometry represents a large fraction of the observations conducted in the Magellanic Cloud clusters. Many studies aim at obtaining new colour-magnitude diagrams to infer the age, compare with theoretical isochrones and determine the luminosity function. CCD photometry is also used to discover and observe variable stars in Magellanic Cloud clusters: cepheids (52.156.057), RR Lyrae (52.154.024, 55.154.017, 56.156.008, Welch et al 1993) or other (eclipsing binaries, Be variables) (52.153.045, 55.154.055, Balona 1993). Integrated photometry has been performed by Bica et al (54.156.034). UBV photometry is now available for 624 LMC clusters. Elson (53.156.147) presented surface-brightness profile and colour-magnitude diagrams for 18 LMC star clusters. The profiles of the older clusters are well represented by models with a King-like core, while younger clusters show departure from such models. Olszewski et al (53.156.017) measured the radial velocity and equivalent width of the calcium triplet at $\lambda \sim 8500$ Å for more than 150 stars in 80 LMC clusters. They obtained an estimate of the metallicity and found little radial abundance gradient in the LMC. The structure of three LMC clusters has been investigated by measuring the core velocity dispersion from integrated light spectra (52.154.032). The inferred structure is similar to that of galactic globular clusters. The detailed structure and dynamics of NGC 1850 (Fischer et al 1993), NGC 1866 (55.154.015), NGC 1978 (56.151.010) have been studied by CCD images over a large field and radial velocities of supergiant members.
Theoretical isochrones have been compared to the colour-magnitude diagrams of LMC clusters to check for envelope semiconvection and core overshooting (54.154.032, 56.156.006) or canonical models (54.156.023).

Balona L.A. 1993, MNRAS 260, 795
Fischer P., Welch D.L., Mateo M. 1993, AJ 105, 938
Welch D.L., Mateo M., Olszewski E.W., Fischer P., Takamiya M. 1993, AJ 105, 146

7.2 Small Magellanic Cloud clusters

Kontizas (52.156.006) examined the morphology of 34 populous SMC clusters and measured the projected ellipticity. The inner-region clusters seem more elliptic than the outer ones. The SMC clusters are on the whole more elliptic than the LMC clusters.

7.3 Cluster-by-clusters literature citations

NGC 121
54.154.004 UBVRI phot seq.
NGC 152
Alvarado (1993) UBVRI pe phot, seq.
NGC 330
54.154.001 C,N abund.
54.154.069 C,N,O,Fe abund.
55.154.001 uvby CCD phot, metal.
55.154.003 Hα, uvby CCD phot, Be st.
55.154.055 short per var st.
55.156.047 IUE UV obs.
Caloi et al (1993) IUE obs, blue st.
NGC 456
53.156.056 sp cl.
NGC 460ab
53.156.056 sp cl.
NGC 465
53.156.056 sp cl.
NGC 1466
56.156.008 phot, RR Lyr var.
NGC 1711
52.153.060 CCD phot.
54.154.031 mf.
54.156.005 BV CCD phot.
Subramaniam et al (1993) st distr.
NGC 1712
52.153.045 CCD phot, var st.
52.153.061 CCD phot.
NGC 1722
52.153.061 CCD phot.
NGC 1727
52.153.061 CCD phot.
NGC 1831
56.156.006 BV CCD phot.
NGC 1835
52.154.032 vel dis, m/l ratio.
NGC 1841
52.154.024 BV CCD phot, RR Lyr st.
56.156.007 sp, vel, metal.
NGC 1850
Fischer et al (1993) dyn, dbl cl.
NGC 1866
53.122.001 CCD phot, sp, rv, var st.
53.122.012 B-W radius, cep var.
54.154.032 test mod.
55.154.015 V CCD image, rv, dyn.
Welch & Stetson (1993) search var st.
NGC 1978
56.151.010 BV CCD image, rv rg, dyn.
Alvarado (1993) UBVRI pe phot, seq.
NGC 2004
54.154.031 mf.
54.156.005 BV CCD phot.
54.156.023 BV CCD phot.
Balona (1993) CCD monit, short per var.
Balona & Jerzykiewicz (1993) UBV CCD phot.
Subramaniam et al (1993) st distr.
NGC 2031
Mould et al (1993) BR CCD phot, age.
NGC 2100
54.154.031 mf.
54.156.005 BV CCD phot.
Balona (1993) CCD monit, short per var.
Balona & Jerzykiewicz (1993) UBV CCD phot.
Subramaniam et al (1993) st distr.
NGC 2121
Alvarado (1993) UBVRI pe phot, seq.
NGC 2157
52.154.057 Cep var.
NGC 2164
53.154.008 BV CCD phot.
54.154.031 mf.
54.156.005 BV CCD phot.
Subramaniam et al (1993) st distr.
Welch et al (1993) BV CCD phot, var st.
NGC 2210
56.122.006 pe, pg, CCD phot, var st.
NGC 2214
54.154.025 CCD phot, rgb.
54.154.031 mf.
54.156.005 BV CCD phot.
56.154.065 UBVI CCD phot, age.
Subramaniam et al (1993) st distr.
Hen N59A
56.156.012 UBV phot, st cont.
Hen N90
53.156.031 opt, UV sp, O,B st.
Hen N159A
55.132.025 OB st, st cont.
56.156.002 UBVRI CCD phot
Lindsay 11
56.154.075 BR CCD phot, age.
30 Dor
53.156.033 review.
53.156.143 X-ray image.
54.156.002 st form.
55.156.031 UBV phot, sp cl.
56.153.008 HST PC image, 12 st.
56.153.020 HST UB phot.
56.156.013 ASTRO-1, UIT image.
56.156.015 IR survey, proto st.
56.156.018 UBV phot, sp cl, imf.
GLC0435-59
55.154.017 BV CCD phot, RR Lyr var.
53.156.017 rv, 150 st, 80 cl.
53.156.092 cat bin cl.
54.156.034 UBV int col, 64 cl.
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8 Clusters in other galaxies

The review by Harris (1992) on globular systems in other galaxies emphasizes the results obtained during the past decade.

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52.154.044 spect, metal.
53.157.023 CCD image.
53.154.028 metal 150 clus.
53.157.017 tidal radii glob clus.
56.157.005 age, metal.
56.157.006 spect smr cl.
56.157.044 clus lf.
56.157.185 JHK phot.
Battistini et al (1993) new clus.
NGC 598, M33
53.157.024 vel, kin, vel disp.
NGC 1275
52.157.102 young clus, Hα em.
NGC 1399
53.157.016 BV CCD phot, prop.
53.157.047 BV CCD phot, prop.
Ostrov et al (1993) metal grad, distr.
NGC 1404
56.157.046 glob syst.
NGC 3031, M81
54.154.028 BV pg phot.
NGC 4365
53.154.034 B CCD phot, lf.
NGC 4472
53.154.034 B CCD phot, lf.
NGC 4649
53.154.034 B CCD phot, lf.
NGC 5128
56.157.033 Wash phot, metal.
NGC 7814
56.157.106 detec glob clus.
Fornax
56.157.249 vel disp, metal.

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